Deep Learning Approaches for Data Augmentation in Medical Imaging: A Review

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Abstract

Deep learning has become a popular tool for medical image analysis, but the limited availability of training data remains a major challenge, particularly in the medical field where data acquisition can be costly and subject to privacy regulations. Data augmentation techniques offer a solution by artificially increasing the number of training samples, but these techniques often produce limited and unconvincing results. To address this issue, a growing number of studies have proposed the use of deep generative models to generate more realistic and diverse data that conform to the true distribution of the data. In this review, we focus on three types of deep generative models for medical image augmentation: variational autoencoders, generative adversarial networks, and diffusion models. We provide an overview of the current state of the art in each of these models and discuss their potential for use in different downstream tasks in medical imaging, including classification, segmentation, and cross-modal translation. We also evaluate the strengths and limitations of each model and suggest directions for future research in this field. Our goal is to provide a comprehensive review about the use of deep generative models for medical image augmentation and to highlight the potential of these models for improving the performance of deep learning algorithms in medical image analysis.